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NASA/SP—1999–7037/SUPPL392
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Includes aircraft simulation technology.

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07 Aircraft Propulsion and Power 8

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Typical Report Citation and Abstract

❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
❷ Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10° to 50°, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65° swept forebody serrations tended to roll together, while vortices from 40° swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
5. Contract/Grant Number(s)
6. Report Number(s); Availability and Price Codes
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9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 392)

JANUARY 22, 1999

01
AERONAUTICS

19990008744 National Aerospace Lab., Tokyo, Japan
Proceedings of the NAL Symposium on Aircraft Computation Aerodynamics
Feb. 1998; 362p; In Japanese; In English; 15th; Aircraft Computation Aerodynamics, 12-13 Jun. 1997, Tokyo, Japan; Original contains color illustrations
Report No.(s): PB99-108979; NAL-SP-37; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Partial Contents: CFD code developments and validations at ONEA for helicopter applications; Inverse Design Method for Wing of Supersonic Transport; Study on Transonic Flutter Characteristics of an Arrow Wing Configuration; Aerodynamic Analysis of Helicopter Rotor by Coupling of CFD and Trim Calculation Advanced Technology Institute of Commuter-helicopter; A Numerical Simulation of Flow around Rotor Blades using Overlapped Grid Advanced Technology Institute of Commuter-helicopter; and Thin Body Treatment on Unstructured, Cartesian Grid.
NTIS
Aerodynamic Characteristics; Aerodynamic Configurations; Helicopters; Computational Fluid Dynamics; Design Analysis; Transonic Flutter; Conferences; Flutter Analysis; Aircraft Structures; Numerical Flow Visualization

19990008836 National Aerospace Lab., Tokyo, Japan
Estimation of Aerodynamic Derivatives of B-65 Queen Air by the Equation Error Method
Masui, K., National Aerospace Lab., Japan; Tsukano, Y., National Aerospace Lab., Japan; Apr. 1997; 56p; In Japanese; Portions of this document are not fully legible
Report No.(s): PB99-108961; NAL-TR-1324; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The longitudinal aerodynamic derivatives of a B-65 were estimated directly from the time histories of several maneuvers by two types of equation error method: the conventional least squares (LS) method and the total least squares (TLS) method. The estimated results were compared with those of the frequency response method. The LS and TLS methods can greatly reduce the time for flight tests without a special device to generate a specific shape of input.
NTIS
Aerodynamics; Errors; Flight Tests; Error Analysis

19990008837 National Aerospace Lab., Tokyo, Japan
Aerodynamic Characteristics of Hypersonic Flight Experiment (HYFLEX) Vehicle
Dec. 1997; 108p; In Japanese; Portions of this document are not fully legible
Report No.(s): PB99-108953; NAL-TR-1334; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The Hypersonic Flight Experiment (HYFLEX) vehicle successfully performed a hypersonic lifting flight. The vehicle was developed to establish the basic technologies necessary for an unmanned shuttle vehicle. In this report, the primary aerodynamic characteristics derived from analysis of the flight data are presented. They are aerodynamic force coefficients, longitudinal trim characteristics, stability and control derivatives, elevon hinge moment coefficient, and surface pressure distribution. The flight results are compared with the preflight predictions based on wind tunnel tests and CFD calculations. The purpose of the comparison is to evaluate the validity of the prediction methods including the development of aerodynamic uncertainties in the vehicle design process. The flight results agreed well with the predictions. This shows that the prediction methods are generally valid for

the design of a lifting reentry vehicle with a high angle of attack. On the other hand, some differences between the flight results and the predictions were found in axial force coefficient, elevon trim deflection, and RCS gas-jet interaction. The causes of these are also discussed in this report.
NTIS
Hypersonic Vehicles; Hypersonic Flight; Aerodynamic Configurations; Computational Fluid Dynamics; Wind Tunnel Tests; Aerodynamic Balance

19990088871 NASA Langley Research Center, Hampton,VA USA
Aeronautical Engineering: A Continuing Bibliography with Indexes, Supplement 390
Dec. 25, 1998; 54p; In English
Report No.(s): NASA/SP-1998-7037/SUPPL390; NAS 1.21:7037/SUPPL390; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
This report lists reports, articles and other documents recently announced in the NASA STI Database.
Author
Aeronautical Engineering; Bibliographies

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces, and internal flow in ducts and turbomachinery.

19990088829 NASA Langley Research Center, Hampton, VA USA
X-33 Metallic TPS Tests in NASA-LaRC High Temperature Tunnel
Bouslog, Stanley A.; Goodrich (B. F.) Aerospace, USA; Moore, Brad, Goodrich (B. F.) Aerospace, USA; Scanlon, Ron J., Goodrich (B. F.) Aerospace, USA; Sawyer, James Wayne, NASA Langley Research Center, USA; 1998; 7p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NCC8-115; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Conclusions The first series of metallic TPS tests in the NASA-LaRC Mach 7 High Temperature Tunnel has been completed. Additional testing is in progress and shall provide data for off-design configurations for the metallic TPS. The available data are being analyzed and being used to correlate analytical models to be used for X-33 flight design analysis. The final paper shall present additional data from these tests and comparisons between the data and analytical predictions.
Author
Wind Tunnel Tests; Design Analysis; X-33 Reusable Launch Vehicle

19990088832 NASA Lewis Research Center, Cleveland, OH USA
Tone Noise and Nearfield Pressure Produced by Jet-Cavity Interaction
Raman, Ganesh, DYNACS Engineering Co., Inc., USA; Envia, Edmane, NASA Lewis Research Center, USA; Bencic, Timothy J., NASA Lewis Research Center, USA; Nov. 1998; 32p; In English; 37th; Aerospace Sciences Meeting and Exhibit, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Contract(s)/Grant(s): NAS3-27186; RTOP 522-31-23
Report No.(s): NASA/TM-1998-208836; NAS 1.16:208836; AIAA Paper 99-0604; E-11381; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Cavity flow resonance can cause numerous problems in aerospace applications. While our long-term goal is to understand cavity flows well enough to devise effective cavity resonance suppression techniques, this paper describes a fundamental study of resonant tones produced by jet-cavity interaction at subsonic and supersonic speeds. Our specific jet-cavity configuration can also be used as a test bed for evaluating active and passive flow resonance control concepts. Two significant findings emerge from this study. 1) Originally, we expected that tones produced by jet-cavity interaction would resemble cavity tones or jet tones or would involve some simple combinations of each. The experimental data do not support these expectations: instead, the jet cavity interaction produce a unique set of tones. We propose simple yet and physically insightful correlations for these tones. Although the pressure patterns on the cavity floor display very complex variations with the Mach number for a length/depth = 8 cavity, the tones correspond to the acoustic modes of the cavity-independent of flow. For a length/ depth = 3 cavity, however, a surprise emerges: the pressure patterns on the cavity floor are not so complex but the tones depend significantly on the flow. Additionally, we examine the role of external feedback unique to jet-cavity interaction. 2) Previous research led us to expect that traditional classifications (open, transitional, or closed) for cavities in an infinite flight stream would be insensitive to small changes in Mach

number and would depend primarily on cavity length/depth ratios. Use of the novel high resolution photoluminescent pressure sensitive paint shows that the classifications are actually quite sensitive to jet Mach number for a length/depth = 8 cavity. However, these classifications provide no guidance whatsoever for tone amplitude or frequency. Detailed experimental data and insights presented here will assist researchers who are performing numerical simulations of jet-cavity flows as a first step toward devising resonance suppression methods.

Author

Acoustic Properties; Aerospace Engineering; Cavities; Cavity Flow; Cavity Resonators; Control Theory; Photoluminescence; Subsonic Speed; Supersonic Speed

19990089046 NASA Langley Research Center, Hampton, VA USA

Overview of Sensitivity Analysis and Shape Optimization for Complex Aerodynamic Configurations

Newman, Perry A., NASA Langley Research Center, USA; Newman, James C., III, Mississippi State Univ., USA; Barnwell, Richard W., Virginia Consortium for Engineering and Science, USA; Taylor, Arthur C., III, Old Dominion Univ., USA; Hou, Gene J.-W., Old Dominion Univ., USA; Jun. 1998; 24p; In English

Contract(s)/Grant(s): NAG1-1265; NGT5-1247; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a brief overview of some of the more recent advances in steady aerodynamic shape-design sensitivity analysis and optimization, based on advanced computational fluid dynamics. The focus here is on those methods particularly well-suited to the study of geometrically complex configurations and their potentially complex associated flow physics. When nonlinear state equations are considered in the optimization process, difficulties are found in the application of sensitivity analysis. Some techniques for circumventing such difficulties are currently being explored and are included here. Attention is directed to methods that utilize automatic differentiation to obtain aerodynamic sensitivity derivatives for both complex configurations and complex flow physics. Various examples of shape-design sensitivity analysis for unstructured-grid computational fluid dynamics algorithms are demonstrated for different formulations of the sensitivity equations. Finally, the use of advanced, unstructured-grid computational fluid dynamics in multidisciplinary analyses and multidisciplinary sensitivity analyses within future optimization processes is recommended and encouraged.

Author

Aerodynamic Configurations; Computational Fluid Dynamics; Design Analysis; Fluid Dynamics; Unstructured Grids (Mathematics)

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations, and aircraft accidents.

19990086599 Federal Aviation Administration, Technical Center, Atlantic City, NJ USA

Cargo Compartment Fire Protection in Large Commercial Transport Aircraft

Blake, David, Federal Aviation Administration, USA; Marker, Timothy, Federal Aviation Administration, USA; Hill, Richard, Federal Aviation Administration, USA; Reinhardt, John, Federal Aviation Administration, USA; Sarkos, Constantine, Federal Aviation Administration, USA; Jul. 1998; 25p; In English

Report No.(s): AD-A355109; DOT/FAA/AR-TN98/32; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes recent research by the Federal Aviation Administration (FAA) related to cargo compartment fire protection in large transport aircraft. A gaseous hydrofluorocarbon, HFC-125, was compared to Halon 1301 in terms of fire suppression effectiveness and agent decomposition levels in the cargo compartment and passenger cabin during full-scale tests involving a bulk-loaded cargo fire. Also, a zoned water mist system was designed and evaluated against a bulk-loaded cargo fire. An exploding aerosol can simulator is being developed to provide a repeatable fire threat for evaluation of new halon replacement agents. The potential severity of an exploding aerosol can inside a cargo compartment and the effectiveness of Halon 1301 inserting was demonstrated. Tests were also conducted to determine the effectiveness of Halon 1301 against a cargo fire involving oxygen canisters. Finally, HFC-125 was evaluated for use as a simulant for Halon 1301 during cargo compartment approval testing to demonstrate compliance with applicable FAA regulations.

DTIC

Research; Cargo; Commercial Aircraft; Fire Prevention; Safety; Transport Aircraft; Threat Evaluation

19990008869 Air Force Inst. of Tech., School of Logistics and Acquisition Management, Wright-Patterson AFB, OH USA
The Newest Seamless Airlifter: The C-130J-30
Haven, Douglas L.; Jun. 1998; 53p; In English
Report No.(s): AD-A355606; AFIT/GMO/LAL/98J-8; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The end of the Cold War has had a dramatic effect on America's national security strategy. As the peace dividend continues to yield defense cuts and force reductions throughout the world, we have moved from a forward presence force to a force projection force. Airlift is vital as a first response to any action that requires an American presence. Whether it involves airlifting supplies and personnel into Bosnia in support of IFOR or enforcing sanctions on Iraq, adherence to AMC's Core Competency of Global Reach will continue to place demands on our airlift resources. This demand must be met with a well thought-out employment strategy for all of AMC's airlift assets. The harsh reality is that in the future our airlift assets will experience shortfalls in capability, creating challenges for any transportation system we build. These challenges will force us to develop innovative ways to employ these assets if we hope to meet the demands of projecting those forces anywhere in the world. One airlift asset that will expand our employment options is the next generation Hercules, the C-130J-30. The J-30 is destined to become a part of the airlift picture in the near future and evaluations are under way on how to best utilize it. Should the USAF employ it purely in its traditional intra-theater role, or expand it into the intertheater role? This paper looks at the difference between these roles, examines the traditional role of the C-130, and how this has shaped the way we do business today.
DTIC
C-130 Aircraft; Rescue Operations; Air Transportation

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft, air navigation systems (satellite and ground based), and air traffic control.

19990008576 NASA Pasadena Office, CA USA
Robust Real-Time Wide-Area Differential GPS Navigation
Yunck, Thomas P., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Bertiger, William I., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Lichten, Stephen M., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Mannucci, Anthony J., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Muellerschoen, Ronald J., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Wu, Sien-Chong, Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Oct. 27, 1998; 9p; In English
Patent Info.: Filed 29 Mar. 1996; NASA-Case-NPO-19625-1-CU; US-Patent-5,828,336; US-Patent-Appl-SN-628566; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

The present invention provides a method and a device for providing superior differential GPS positioning data. The system includes a group of GPS receiving ground stations covering a wide area of the Earth's surface. Unlike other differential GPS systems wherein the known position of each ground station is used to geometrically compute an ephemeris for each GPS satellite, the present system utilizes real-time computation of satellite orbits based on GPS data received from fixed ground stations through a Kalman-type filter/smoother whose output adjusts a real-time orbital model. the orbital model produces and outputs orbital corrections allowing satellite ephemerides to be known with considerable greater accuracy than from the GPS system broadcasts. The modeled orbits are propagated ahead in time and differenced with actual pseudorange data to compute clock offsets at rapid intervals to compensate for SA clock dither. The orbital and clock calculations are based on dual frequency GPS data which allow computation of estimated signal delay at each ionospheric point. These delay data are used in real-time to construct and update an ionospheric shell map of total electron content which is output as part of the orbital correction data, thereby allowing single frequency users to estimate ionospheric delay with an accuracy approaching that of dual frequency users.
Official Gazette of the U.S. Patent and Trademark Office
Global Positioning System; Kalman Filters; Satellite Orbits; Real Time Operation; Navigation Satellites

19990009091 National Aerospace Lab., Tokyo, Japan
Development of a Laser Tracker and Its Evaluation by Flight Testing
Ono, T., National Aerospace Lab., Japan; Okada, N., National Aerospace Lab., Japan; Inagaki, T., National Aerospace Lab., Japan; Inokuchi, H., National Aerospace Lab., Japan; Harigae, M., National Aerospace Lab., Japan; Jul. 1998; 38p; In Japanese; Portions of this document are not fully legible
Report No.(s): PB99-108870; NAL-TR-1331; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Research is being conducted on flight tests for approach and landing navigation using the NAL Do-228 research airplane and the unmanned vehicle ALFLEX under a joint research project with NAL and NASDA. On these flights, an evaluation of the flight path and navigation sensors was required. The laser tracker was developed for this purpose. This paper outlines the development of the laser tracker and its evaluation based on flight test results. For the accuracy evaluation, laser tracker and its evaluation based on flight test results. For the accuracy evaluation, laser tracker data were compared with kinematic GPS data using on onboard GPS receiver and a ground station GPS receiver. The laser tracker was found to have the required accuracy.
NTIS
Lasers; Flight Tests; Navigation; Automatic Landing Control; Global Positioning System; Tracking (Position)

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology

19990008563 Advisory Group for Aerospace Research and Development, Flight Vehicle Integration Panel, Neuilly-Sur-Seine, France
Enhancement of Aircraft Ground Handling Simulation Capability *L'Amelioration des Moyens de Simulation des Manoeuvres au Sol des Aeronefs*
Barnes, A. G., Advisory Group for Aerospace Research and Development, France; Yager, T. J., NASA Langley Research Center, USA; Aug. 1998; 88p; In English
Report No.(s): AGARD-AG-333; AGARDograph-333; ISBN 92-836-1066-0; Copyright Waived; Avail: CASI; A05, Hardcopy; A01, Microfiche
This report is a guide to methods of representing in a flight simulator, the stability and control of an aircraft on the ground. It updates an earlier publication, AGARDograph 285, in the light of simulation technology improvements over a ten year period. Emphasis is placed on the modeling of the vehicle dynamics, and on the modeling of the tire forces generated by the runway surface. Areas are identified where some current simulators are deficient. The different needs of pilot-in-the-loop and non-real-time simulations are discussed, and topics for further research are identified.
Author
Flight Simulators; Ground Handling; Computerized Simulation; Mathematical Models; Pilot Support Systems; Flight Simulation

19990008588 NASA Ames Research Center, Moffett Field, CA USA
Tip Fence for Reduction of Lift-Generated Airframe Noise
Ross, James C., Inventor, NASA Ames Research Center, USA; Storms, Bruce L., Inventor, NASA Ames Research Center, USA; Apr. 14, 1998; 10p; In English
Patent Info.: Filed 8 Jun. 1995; NASA-Case-ARC-14009-1-LE; US-Patent-5,738,298; US-Patent-Appl-SN-482459; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche
The present invention is directed toward a unique lift-generated noise reduction apparatus. This apparatus includes a plurality of tip fences that are secured to the trailing and leading assemblies of the high-lift system, as close as possible to the discontinuities where the vortices are most likely to form. In one embodiment, these tip fences are secured to some or all of the outboard and inboard tips of the wing slats and flaps. The tip fence includes a generally flat, or an aerodynamically shaped plate or device that could be formed of almost any rigid material, such as metal, wood, plastic, fiber glass, aluminum, etc. In a preferred embodiment, the tip fences extend below and perpendicularly to flaps and the slats to which they are attached, such that these tip fences are aligned with the nominal free stream velocity of the aircraft. In addition to reducing airframe noise, the tip fence tends to decrease drag and to increase lift, thus improving the overall aerodynamic performance of the aircraft. Another advantage presented by the tip fence lies in the simplicity of its design, its elegance, and its ready ability to fit on the wing components, such as the flaps and the slats. Furthermore, it does not require non-standard materials or fabrication techniques, and it can be readily, easily and inexpensively retrofited on most of the existing aircraft, with minimal design changes.
Official Gazette of the U.S. Patent and Trademark Office
Aircraft Structures; Aerodynamic Noise; Aerodynamic Configurations; Aircraft Noise; Noise Reduction; Aircraft Design

19990008654 NASA Lewis Research Center, ClevelandOH USA
Design, Installation, and Evaluation of an Altitude Test Facility Modification
Abdelwahab, Mahmood, NASA Lewis Research Center, USA; Moore, Allan S., NASA Lewis Research Center, USA; Soeder, Ronald H., NASA Lewis Research Center, USA; Sorge, Richard N., NASA Lewis Research Center, USA; DelRoso, Richard,

NASA Lewis Research Center, USA; Dicki, Dennis J., DYNACS Engineering Co., Inc., USA; Nov. 1998; 46p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS3-27186; RTOP 523-91-13
Report No.(s): NASA /TM-1997-206323; E-11016; NAS 1.15:206323; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the design, installation, and evaluation of the turbine engine altitude test facility modifications. This facility is located in test cell 4 (PSL4) at the Lewis Research Center Propulsion Systems Laboratory (PSL). The modifications were made to enhance the test cell capability for engine inlet air supply conditions from a prior maximum of 55 psia and 600 F to a new rating of 165 psia and 1200 F. The maximum conditions reached during the interim evaluation were 129 psia and 844 F at an airflow of 159 lb/sec. Also, the modified facility airflow quality as defined by the flow characteristics at a typical gas turbine engine inlet were investigated and were adequate.
Author
Engine Tests; Altitude Tests; Engine Inlets; Air Flow; Test Facilities; Test Ranges

19990008707 Boeing Co., Rotorcraft Div., Philadelphia, PA USA
Advanced Maintenance Aid Concepts *Final Report, May 1997 - Nov. 1998*
Cushman, Robert; Sawaya, John; Beggs, Robert; Oct. 15, 1998; 40p; In English
Contract(s)/Grant(s): DAAJ09-95-G-0018
Report No.(s): AD-A355036; USAAMCOM-TR-98-D-25; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Advanced Maintenance Aid Concepts (AMAC) Final Report summarizes the effort to analyze, design and prototype a next-generation portable maintenance aid for the CH-47 Chinook helicopter. The AMAC Demonstrator supports both the traditional phase maintenance system used today as well as multiple, flexible maintenance management schemes responsive to operation within a digital aviation logistics (DAL) environment.
DTIC
Prototypes; CH-47 Helicopter; Digital Systems

19990008713 Federal Aviation Administration, Office of Aviation Research, Washington, DC USA
Effects of Concentrated Hydrochloric Acid Spills on Aircraft Aluminum Skin
Speitel, Louise C.; Jul. 1998; 13p; In English
Report No.(s): AD-A355072; DOT/FAA/AR-TN-97/108; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This document describes the tests conducted to evaluate the effects of a spill of a strong corrosive acid such as hydrochloric acid (HCl) on aircraft interior skin and to determine the time required for a spill of Department of Transportation (DOT) allowable volumes and concentrations to cause catastrophic failure. Test data indicate that the epoxy coated interior aluminum skin is resistant to acid attack. The acid reacted vigorously with scratched skin surfaces, creating a wide hole in the skin along the scratch line. Test data also indicate that a spill of concentrated HCl can eat completely through the rivets and ribs and may result in a significant loss of structural rib strength.
DTIC
Aircraft Compartments; Aluminum; Coatings; Corrosion; Epoxy Resins

19990008736 Department of Transportation, John A. Volpe National Transportation Systems Center, Cambridge, MA USA
Development of Noise Dose/Visitor Response Relationships for the National Parks Overflight Rule: Bryce Canyon National Park Study *Final Report, May 1997 - Jul. 1998*
Fleming, Gregg G.; Roof, Christopher J.; Rapoza, Amanda S.; Read, David R.; Webster, Joel C.; Jul. 1998; 258p; In English
Contract(s)/Grant(s): PA865/AB012
Report No.(s): AD-A355018; DOT-VNTSC-FAA-98-6; FAA-AEE-98-01; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The Federal Aviation Administration's Office of Environment and Energy, with the assistance of the Acoustics Facility at the USA Department of Transportation's John A. Volpe National Transportation Systems Center is conducting research in support of the National Parks Overflight Rule (National Rule). The foundation of the research program for the National Rule is the performance of noise dose/visitor response (dose-response) studies in several National Parks. This document summarizes the results of a dose-response study conducted along two separate segments of a frontcountry, short-hike trail at Bryce Canyon National Park during the period August 19 through 27, 1997.
DTIC
Noise Pollution; Acoustics; Dosage; Aircraft Noise

19990808842 Naval Postgraduate School, Monterey, CA USA

An Evaluation of Markov Chain Modeling for F/A-18 Aircraft Readiness

Ackart, Leigh P.; Sep. 1998; 57p; In English

Report No.(s): AD-A355761; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

During its 1998 deployment the USS INDEPENDENCE (CV 62) and Carrier Air Wing Five operated under the control of Commander, Task Force 50 (CTF-50). To balance resources and readiness, CTF-50 asked the following question: "How many days can the USS INDEPENDENCE go without "off ship" logistics support before the number of Mission Capable aircraft can be expected to fall below Chief of Naval Operations readiness goals?" This thesis develops a Markov chain model to answer this question. Explanatory variables for this model include sorties flown, cannibalization rate and frequency of "off ship" logistics support. Using data from INDEPENDENCE, this thesis analyzes aviation readiness by estimating the number of F/A-18 aircraft capable of performing at least one of its intended missions. Both non-linear Markov models and Generalized Linear Models are employed to estimate the effect of the operating environment on the number of mission capable aircraft available. The analysis demonstrates how the Markov approach captures the cyclic nature of aircraft operations and maintenance. Specifically, it is shown that INDEPENDENCE can expect to operate five to eight days without "off ship" logistics support before F/A-18 MC rates fall below CNO readiness goals. Recommendations for further studies are included.

DTIC

Aircraft Carriers; Markov Processes; F-18 Aircraft; Markov Chains; Flight Operations

19990808962 Virginia Univ., Dept. of Civil Engineering, Charlottesville, VA USA

Void Nucleation and Growth in Nonlinear Solids *Final Report, 9 Jan. 1994 - 30 Aug. 1998*

Horgan, Cornelius O.; Aug. 30, 1998; 15p; In English

Contract(s)/Grant(s): F49620-94-1-0349; AF Proj. 2304

Report No.(s): AD-A355829; UVA/525800/CE99/102; AFRL-SR-BL-TR-98-0696; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Thin-walled structures of interest to the U. S. Air Force, such as aircraft fuselages, rocket casings, helicopter blades, and containment vessels, are often constructed of layers of anisotropic, filament or fiber-reinforced materials which must be designed to remain elastic. Our research has been concerned with load diffusion in such structures. An understanding of the fundamental mechanisms of load diffusion in composite subcomponents is essential in developing primary composite structures. Analytical models of load diffusion behavior are extremely valuable in building an intuitive base for developing refined modeling strategies and assessing results from finite element analyses. The decay behavior of stresses and other field quantities provides a significant aid towards this process. Our results are also useful for structural tailoring.

DTIC

Composite Structures; Diffusion; Fiber Composites; Finite Element Method; Helicopters; Loads (Forces); Mathematical Models; Thin Walls

19990809070 D[illegible]cience and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia

Analysis of the I[illegible]raction Effect for Bonded Repairs

Callinan, R. J.; Rose, L. R.; Sanderson, S.; Aug. 1998; 26p; In English

Report No.(s): AD-A355822; DSTO-TR-0715; DODA-AR-010-621; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

With the increasing use of bonded repairs to restore the structural integrity of ageing aircraft the question arises as to the interaction effects when repairs are located close together. Using the Finite Element (F.E.) method a study has been carried out for the interaction between two idealised circular repairs. The interaction involves the increase of the sheet stress just outside the patch. It has been found that the tandem orientation, with respect to the applied load, is the most severe configuration. In this case, for most practical repairs, the interaction may result in increases of the sheet stress by 40% for very close separation distances. It has also been found that certain combinations of bi-axial load can also significantly influence the interaction effect.

DTIC

Axial Loads; Finite Element Method; Structural Failure

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19990008859 NASA Lewis Research Center, Cleveland, OH USA
Model-Based Fault Diagnosis for Turboshaft Engines
Green, Michael D., Florida Atlantic Univ., USA; Duyar, Ahmet, Florida Atlantic Univ., USA; Litt, Jonathan S., NASA Lewis Research Center, USA; Nov. 1998; 10p; In English; Fault Detection, Supervision and Safety for Technical Processes - SAFEPROCESS '97, 26-28 Aug. 1997, Kingston Upon Hull, UK; Sponsored by International Federation of Automatic Control, Germany
Contract(s)/Grant(s): RTOP 505-62-50; DA Proj. 1H-61102-AH-45
Report No.(s): NASA/TM-1998-208825; NAS 1.15:208825; ARL-TR-1447; E-11433; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Tests are described which, when used to augment the existing periodic maintenance and pre-flight checks of T700 engines, can greatly improve the chances of uncovering a problem compared to the current practice. These test signals can be used to expose and differentiate between faults in various components by comparing the responses of particular engine variables to the expected. The responses can be processed on-line in a variety of ways which have been shown to reveal and identify faults. The combination of specific test signals and on-line processing methods provides an ad hoc approach to the isolation of faults which might not otherwise be detected during pre-flight checkout.
Author
Turbine Engines; Turboshafts; Error Analysis; Systematic Errors

19990008889 NASA Ames Research Center, Moffett Field, CA USA
Neural Net-Based Redesign of Transonic Turbines for Improved Unsteady Aerodynamic Performance
Madavan, Nateri K., NASA Ames Research Center, USA; Rai, Man Mohan, NASA Ames Research Center, USA; Huber, Frank W., Riverbed Design Services, USA; Nov. 1998; 20p; In English; 35th; Propulsion, 20-24 Jun. 1999, Los Angeles, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 519-40-12
Report No.(s): NASA/TM-1998-208754; A-9900398; NAS 1.15:208754; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A recently developed neural net-based aerodynamic design procedure is used in the redesign of a transonic turbine stage to improve its unsteady aerodynamic performance. The redesign procedure used incorporates the advantages of both traditional response surface methodology (RSM) and neural networks by employing a strategy called parameter-based partitioning of the design space. Starting from the reference design, a sequence of response surfaces based on both neural networks and polynomial fits are constructed to traverse the design space in search of an optimal solution that exhibits improved unsteady performance. The procedure combines the power of neural networks and the economy of low-order polynomials (in terms of number of simulations required and network training requirements). A time-accurate, two-dimensional, Navier-Stokes solver is used to evaluate the various intermediate designs and provide inputs to the optimization procedure. The optimization procedure yields a modified design that improves the aerodynamic performance through small changes to the reference design geometry. The computed results demonstrate the capabilities of the neural net-based design procedure, and also show the tremendous advantages that can be gained by including high-fidelity unsteady simulations that capture the relevant flow physics in the design optimization process.
Author
Supersonic Turbines; Navier-Stokes Equation; Fluid Dynamics; Design Analysis; Aerodynamic Characteristics

19990008911 Rolls-Royce Ltd., Colne, Fan Systems, Lancashire, UK
Establishing Best Practice in the Design and Manufacture of Hollow Titanium Fan Blades
Fitzpatrick, G. A., Rolls-Royce Ltd., Colne, UK; Lloyd, A. D., Rolls-Royce Ltd., UK; Nov. 1998; 4p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A01, Hardcopy; A02, Microfiche

Rolls-Royce has designed and developed highly efficient lightweight titanium fans for civil engine applications in the thrust range 22000 lbs to over 100000 lbs. These wide chord fan designs are hollow and snubberless, and their fabrication has required the development of joining and forming technologies as well as a thorough understanding of material behaviour. The first generation wide chord fan design is a honeycomb-cored fabrication. It entered service via the RB211-535E4 aeroengine in 1984. This technology has subsequently been applied to the 14E V2500 engine and the RB211-524G/H powerplants. Technological research continued into the 1990's to develop an alternative lighter fan concept for larger thrust engines. This resulted in the second genera-

tion wide chord fan design which exploits solid-state diffusion bonding for joining the fabrication and superplastic forming for the development of the internal core. As well as reducing component weight, there was also a need to economise product cost and to shorten the design-make process. Rolls-Royce, therefore, launched its Fan Key System to electronically integrate engineering and manufacturing activities whilst, at the same time, incorporating process modelling for the optimisation of the key manufacturing technologies. These latest advances have been applied to the Trent 700 engine which entered service in 1995 and, subsequently, to the Trent 800 powerplant. Their flexibility is now allowing the development of the swept fan concept for higher thrust versions of the Trent 800 engine, and the application of these technologies to appropriate military projects.
Author
Process Control (Industry); Computer Aided Manufacturing; Fan Blades; Fabrication; Titanium; Superplastic Forming; Metal Bonding

19990008961 NASA Lewis Research Center, Cleveland, OH USA
A Simplified Model for the Investigation of Acoustically Driven Combustion Instabilities
Paxson, Daniel E., NASA Lewis Research Center, USA; Quinn, D. Dane, Akron Univ., USA; Nov. 1998; 14p; In English; 34th; Joint Propulsion, 12-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 523-26-13
Report No.(s): NASA/TM-1998-208488; NAS 1.15:208488; AIAA Paper 98-3764; E-11267; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A simplified one-dimensional model of reactive flow is presented which captures features of aeropropulsion systems, including acoustically driven combustion instabilities. Although the resulting partial differential equations are one dimensional, they qualitatively describe observed phenomena, including, resonant frequencies and the admission of both steady and unsteady behavior. A number of simulations are shown which exhibit both steady and unsteady behavior, including flame migration and thermo acoustic instabilities. Finally, we present examples of unsteady flow resulting from fuel modulation.
Author
Acoustic Instability; Combustion; Simulation; Unsteady Flow

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

19990008637 Naval Air Systems Command, Structures Div., Patuxent , MD USA
A Laboratory Development and Networking Concept for Naval Aviation
Schibler, William H., Naval Air Systems Command, USA; Katz, Rodney S., Pacific-Sierra Research Corp., USA; Seals, Kathy, Naval Air Systems Command, USA; Jan. 1998; 22p; In English
Report No.(s): AD-A355242; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a concept for laboratory utilization and networking in support of avionics systems development and integration for Naval Aviation. The Naval development centers for air systems have a number of separate laboratory facilities that deal with the many facets of avionics systems in Navy airborne platforms. The laboratories associated in developing and implementing this concept are those located at the Naval Air Warfare Centers (NAWCs) at Patuxent River MD, China Lake CA and Point Mugu CA. The purpose of exploring and then implementing this concept is to ensure that the Navy makes maximum use of the laboratory resources available, and through networking, provides a capability for multiple center participation in shared program developments. The effort underway is embodied in two elements: Modular Avionics Integration Laboratory (MAIL) and Modular Avionics Integration Network (MAIN). The MAIL element is concerned with the identification and networking together, laboratory resources within the confines of a single development center. The MAIN concept is a networking approach for linking the three centers so that intercenter participation can be achieved for broad scope systems development and integration programs. Taken together, the MAIN and MAIL represent a forward step towards implementing a consistent systems engineering based process for avionics systems evaluation, development and integration for the Navy.
DTIC
Avionics; Computer Networks; Research Facilities; Armed Forces

19990009089 National Aerospace Lab., Tokyo, Japan
Model Following Control Scheme Incorporating Integral Compensator for Multiple Hydraulic Flight Control Systems
Ogawa, T., National Aerospace Lab., Japan; Oct. 1997; 24p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB99-108821; NAL-TR-1336; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Mechanical summing of the output of redundant flight control systems into a single axis shows that the output forces do not always act synchronously, because there are the differences of output in respective systems caused by system parameter variations and disturbances. As a result, operation of the systems is never smooth and the servomechanism is subjected to excessive loads. To prevent these problems, we apply a model following control incorporating an integral compensator to the redundant systems. In this control system, steady state errors doe not arise if the system parameters vary from their nominal values and constant disturbances. Experimental results were demonstrated by operating three-channel electro-hydraulic servosystems.
NTIS

Compensators; Hydraulic Control; Flight Control; Hydraulic Equipment

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19990008840 National Aerospace Lab., Tokyo, Japan
Sting Supporting System with Controllable Roll Mode
Kanda, A., National Aerospace Lab., Japan; Ueda, T., National Aerospace Lab., Japan; Sep. 1997; 30p; In Japanese; Portions of this document are not fully legible
Report No.(s): PB99-108904; NAL-TR-1335; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

To address the wing flutter problem, it is important to take into consideration the anti-symmetric mode since it sometimes becomes the most critical mode. For wind tunnel experiments, the authors made a peculiar supporting system that allows motion of the model about its roll axis. This system also has a function that can constrain rolling motion to stop anti-symmetric mode flutter. Flutter experiments were conducted in TWT (Transonic Wind Tunnel) at NAL. It was confirmed that anti-symmetric mode flutter occurred at the flutter boundary and that the supporting system worked successfully. Moreover, flutter characteristics were analytically examined by DPM (Doublet Point Method).
NTIS

Roll; Flutter Analysis; Transonic Wind Tunnels; Transonic Flutter

19990008857 NASA Lewis Research Center, Cleveland, OH USA
Design, Installation, and Evaluation of an Altitude Test Facility Modification
Abdelwahad, Mahmood, NASA Lewis Research Center, USA; Moore, Allan S., NASA Lewis Research Center, USA; Soeder, Ronald H., NASA Lewis Research Center, USA; Sorge, Richard N., NASA Lewis Research Center, USA; DelRoso, Richard, NASA Lewis Research Center, USA; Dicki, Dennis J., DYNACS Engineering Co., Inc., USA; Nov. 1998; 44p; In English
Contract(s)/Grant(s): NAS3-27186; RTOP 523-91-13
Report No.(s): NASA/TM-1997-206323; NAS 1.15:206323; E-11016; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the design, installation, and evaluation of the turbine engine altitude test facility modifications. This facility is located in test cell 4 (PSL4) at the Lewis Research Center Propulsion Systems Laboratory (PSL). The modifications were made to enhance the test cell capability for engine inlet air supply conditions from a prior maximum of 55 psia and 600 F to a new rating of 165 psia and 1200 F. The maximum conditions reached during the interim evaluation were 129 psia and 844 F at an airflow of 159 lb/sec. Also, the modified facility airflow quality as defined by the flow characteristics at a typical gas turbine engine inlet were investigated and were adequate.
Author

Turbine Engines; Propulsion System Performance; Propulsion System Configurations; Gas Turbine Engines; Flow Characteristics

19990008879 Naval Postgraduate School, Monterey, CA USA
A LabVIEW Based Wind Tunnel Data Acquisition System
Huff, Michael R.; Sep. 1998; 130p; In English
Report No.(s): AD-A355656; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The NPS Aerolab Low Speed Wind Tunnel located in Halligan Hall of the Navy Postgraduate School has been in operation since 1953. Although the tunnel is well maintained, its data acquisition system has not kept pace with modern technology. An effective but affordable solution for acquiring data was needed. It was determined that a software package known as LabVIEW would provide a low cost, data acquisition solution that will enhance the capabilities of the wind tunnel, while at the same time making it more user friendly to faculty and students. The focus of this thesis is the design of a VI that will collect and plot force and moment data from a six component strain gauge balance and yield real time, non-dimensional, force and moment coefficients in six degrees of freedom. Wind tunnel tests consisting of angle-of-attack sweeps in the NPS Aerolab low-speed wind tunnel were conducted to verify (L/D)sp optimized, M=6, conical-flow waverider data obtained in 1994 using a different data acquisition system. Results of current testing substantiate the LabVIEW code and the validity of the 1994 test data. Analysis of the current wind tunnel test data resolved pitching moment concerns related to the 1994 data.
DTIC
Data Acquisition; Low Speed Wind Tunnels; Aerodynamic Coefficients; Applications Programs (Computers); Real Time Operation

10
ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

19990008595 NASA Ames Research Center, Moffett Field, CA USALeading Edge Heat Shield for Wings of SpacecraftStewart, David A., Inventor, NASA Ames Research Center, USA; Jun. 30, 1998; 5p; In English28 Nov. 1995; NASA-Case-ARC-14031-1GE; US-Patent-5,772,154; US-Patent-Appl-SN-563418; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, MicroficheA heat shield for thermally insulating the leading edge of a wing of a spacecraft during ascent and reentry includes a plurality of rigid tiles. Each tile is formed with a pie-shaped element which interlocks with the complementarily-formed element of another tile. The combination of structure afforded by the pie-shaped elements substantially impedes hypersonic flow of any gases that might enter the gaps between tiles. Official Gazette of the U.S. Patent and Trademark Office*Heat Shielding; Wings; Spacecraft Design; Thermal Insulation*

19990008745 NASA Johnson Space Center, Houston, TX USA
STS-95 Day 09 Highlights
Nov. 07, 1998; In English; Videotape: 24 min, 35 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-1998408700; BRF-1416l; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this ninth day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, spend a good part of their day checking out important spacecraft systems for entry and landing. The commander and pilot begin the flight control system checkout by powering up one auxiliary power unit and evaluating the performance of aerodynamic surfaces and flight controls. The flight crew conducts a reaction control system hot fire, followed by a test of the communications system.
CASI
Space Transportation System Flights; Space Transportation System; Spacecrews; Flight Control; Control Surfaces; Auxiliary Power Sources

19990008874 National Aerospace Lab., Tokyo, Japan
Effect of Supersonic Retroject on Capsule Aerodynamic Characteristics in Hypersonic Flow
Watanabe, M., National Aerospace Lab., Japan; Nomura, S., National Aerospace Lab., Japan; Yamamoto, Y., National Aerospace Lab., Japan; Yoshizawa, A., National Aerospace Lab., Japan; Hozumi, K., National Aerospace Lab., Japan; Jul. 1997; 48p; In Japanese; Portions of this document are not fully legible
Report No.(s): PB99-108888; NAL-TR-1329; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The effects of supersonic retrojects on the aerodynamic characteristics of a capsule type model a with a spherical nose of large bluntness were investigated experimentally in a hypersonic flow. Tests were conducted in the NAl phi = 50 cm hypersonic wind

tunnel at conditions of Mach number 7.1, Reynolds number of 40,000/cm and angles of attack from 0 to 15 degrees. The capsule model has the so-called GEMINI type configuration: a spherical forebody with bluntness ratio of 4.0 (spherical nose radius/base radius) followed by a conical boattail and a cylinder. The tests were conducted by focusing on the effect of the blowing rate of a supersonic retroject of a nominal Mach number 3.05 ejected perpendicularly at the capsule nose center and on the effect of model attack angles. The retroject was found to have a large effect on drag and lift coefficients that were calculated by integrating the measured pressure distributions. The aerodynamic interaction phenomena between a main flow and a retroject were studied to understand those effects by investigating Schlieren pictures and surface pressure distribution.
NTIS
Hypersonic Flow; Hypersonic Wind Tunnels; Space Capsules; Aerodynamic Drag

11
CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

19990086643 Federal Aviation Administration, Washington, DC USA
A Review of the Flammability Hazard of Jet A Fuel Vapor in Civil Transport Aircraft Fuel Tanks *Final Report*
Fuel Flammability Task Group, Federal Aviation Administration, USA; Jun. 1998; 62p; In English
Report No.(s): AD-A355165; DOT/FAA/AR-98/26; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report documents the findings of a Fuel Flammability Task Group made up of recognized fuel and combustion specialists investigating the flammability and explosiveness of fuel within an aircraft fuel tank. The task group reviewed all available reports on the subject and met and discussed the data with technical experts from Boeing Commercial Airplane Co., California Institute of Technology, and the National Transportation Safety Board. The scope of the report includes jet fuel definitions and specifications, jet fuel flammability data, influences of various factors on fuel flammability, and predictive analyses and models for flammability. The report discusses the impact of this knowledge on the needs for in-flight fuel fire prevention.
DTIC
Hazards; Fuel Tanks; Transport Aircraft; Jet Engine Fuels; Fire Prevention; Flammability; Vapors

19990085858 NASA Lewis Research Center, Cleveland, OH USA
Determination of Yield in Inconel 718 for Axial-Torsional Loading at Temperatures up to 649 C
Gil, Christopher M., Pennsylvania State Univ., USA; Lissenden, Cliff J., Pennsylvania State Univ., USA; Lerch, Bradley A., NASA Lewis Research Center, USA; Nov. 1998; 36p; In English
Contract(s)/Grant(s): RTOP 523-21-13
Report No.(s): NASA/TM-1998-208658; NAS 1.15:208658; E-11380; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An experimental program has been implemented to determine small offset yield loci under axial-torsional loading at elevated temperatures. The nickel-base superalloy Inconel 718 (IN718) was chosen for study due to its common use in aeropropulsion applications. Initial and subsequent yield loci were determined for solutioned IN718 at 23, 371, and 454 C and for aged (precipitation hardened) IN718 at 23 and 649 C. The shape of the initial yield loci for solutioned and aged IN718 agreed well with the von Mises prediction. However, in general, the centers of initial yield loci were eccentric to the origin due to a strength-differential (S-D) effect that increased with temperature. Subsequent yield loci exhibited anisotropic hardening in the form of translation and distortion of the locus. This work shows that it is possible to determine yield surfaces for metallic materials at temperatures up to at least 649 C using multiple probes of a single specimen. The experimental data is first-of-its-kind for a superalloy at these very high temperatures and will facilitate a better understanding of multiaxial material response, eventually leading to improved design tools for engine designers.
Author
Nickel Alloys; Aircraft Engines; Anisotropy; Heat Resistant Alloys; Torsion

19990080915 Naval Air Systems Command, Aerospace Materials Div., Patuxent , MD USA
Intelligent Processing of P/M Materials
Frazier, William E., Naval Air Systems Command, USA; Waldman, Jeffrey, Drexel Univ., USA; Parrish, Phillip A., MAISYS, Inc., USA; Nov. 1998; 8p; In English; Also announced as 19980008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Emphasis is being placed on the acquisition of affordable, reliable, and sustainable advanced airframes and propulsion systems. Net-shape processing of high performance structural materials is of significant technological interest because of its potential for decreasing the cost and enhancing the performance of these aircraft components. Component cost is reduced because of the intrinsic high material utilization and a reduction in machining and finishing operations. The net-shape, hot isostatic press (HIP) consolidation of particulate materials (P/M) is considered one of the enabling technologies for the consolidation of costly and difficult to melt-process materials. This paper explores the benefits of P/M processing and focuses on the development of an intelligent hot isostatic press (IHIP).

Author

Process Control (Industry); Computer Aided Manufacturing; Hot Isostatic Pressing; Smart Materials; Aircraft Structures; Costs

19990008918 Ecole des Mines, Lab. de Science et Genie des Materiaux Metalliques, Nancy, France

Modelling of Ti Alloy Melting by EBCHM: Impact of Process Parameters for Hard-Alpha Dissolution

Bellot, J. P., Ecole des Mines, France; **Jardy, A.**, Ecole des Mines, France; **Bourguignon, S.**, Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; **Ablitzer, D.**, Ecole des Mines, France; Nov. 1998; 8p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The random occurrence of the hard-alpha defect in rotating part used for aero-engines has been one of the main materials problems in the manufacture of quality titanium alloys for some time. The Electron Beam Cold Hearth Melting (EBCHM) process has shown a great promise in being able to refine Ti alloys and to eliminate hard-alpha inclusions by dissolution or settling. A research programme has been launched, with the aim of specifying the remelting process parameters required for the elimination of the defect. Hence the mathematical model of the refining step of the EBCHR process has been developed at the Nancy School of Mines. The model allows calculation of the maps of the velocity, turbulence intensity, temperature and chemical composition in the cold hearth. An experimental and theoretical studies of the hard-alpha defect behaviour in liquid titanium have been carried out. The experimental part of the work consists in immersing of synthetic defect into a titanium liquid bath for a known length of time and analysing it by microprobe after the experiment. In parallel, a kinetic model of dissolution, which computes the transient diffusion of the interstitial solute with alpha and beta intermediate phases, has been developed. In order to predict the potential removal of this kind of defect during the remelting operation, the calculation of the particle trajectory and the kinetic model of dissolution have been coupled. It allows the simulation of the history of the defect in terms of positions and shrinkage or growth of the particle in the metal liquid bath. Results for different process parameters are presented and discussed.

Author

Process Control (Industry); Computer Aided Manufacturing; Aircraft Engines; Engine Parts; Microanalysis; Mathematical Models; Hearths; Melting; Defects; Titanium Alloys; Refining

19990008919 NASA Langley Research Center, Hampton, VA USA

Automated Fabrication Technologies for High Performance Polymer Composites

Shuart, M. J., NASA Langley Research Center, USA; **Johnston, N. J.**, NASA Langley Research Center, USA; **Dexter, H. B.**, NASA Langley Research Center, USA; **Marchello, J. M.**, Old Dominion Univ., USA; **Grenoble, R. W.**, Old Dominion Univ., USA; Nov. 1998; 12p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

New fabrication technologies are being exploited for building high performance graphite-fiber-reinforced composite structure. Stitched fiber preforms and resin film infusion have been successfully demonstrated for large, composite wing structures. Other automate processes being developed include automated placement of tacky, drapable epoxy towpreg, automated heated head placement of consolidated ribbon/tape, and vacuum-assisted resin transfer molding. These methods have the potential to yield low cost, high performance structures by fabricating composite structures to net shape out-of-autoclave.

Author

Process Control (Industry); Manufacturing; Wings; Composite Structures; Resin Film Infusion; Automatic Control; Graphite-Epoxy Composites; Polymer Matrix Composites

19990008921 Cranfield Univ., Bedford, UK

Process Control of Deposition Profiles in the Manufacture of EB-PVD Thermal Barrier Coatings

Nicholls, J. R., Cranfield Univ., UK; **Pereira, V.**, Cranfield Univ., UK; **Lawson, K. J.**, Cranfield Univ., UK; **Rickerby, D. S.**, Rolls-Royce Ltd., UK; Nov. 1998; 12p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

For many applications of coatings it is often undesirable to have a uniform coating thickness around a component. Thermal barrier coatings on aerofoil components are a particular example where a uniform coating distribution around the blade or vane would degrade aerodynamic performance. It is desirable therefore to limit the thickness of such coatings on the trailing edge of

such components. This paper describes the development of process control models capable of predicting both the deposition rate and column inclination during the deposition of EB-PVD thermal barrier coatings. Thus by programming the rate of rotation and absolute position of blades to be coated relative to the evaporation source it should be possible to predict coating geometries on complex hardware.

Author

Process Control (Industry); Computer Aided Manufacturing; Airfoils; Thermal Control Coatings; Vacuum Deposition

12
ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19990088549 NASA Langley Research Center, Hampton, VA USA

Carbon-Carbon Turbocharger Housing Unit for Intermittent Combustion Engines

Northam, G. Burton, Inventor, NASA Langley Research Center, USA; Ransone, Philip O., Inventor, NASA Langley Research Center, USA; Rivers, H. Kevin, Inventor, NASA Langley Research Center, USA; Sep. 22, 1998; 5p; In English; Provisional of US-Patent-Appl-SN-012940, filed 6 Mar. 1996

Patent Info.: Filed 4 Mar. 1997; NASA-Case-LAR-15496-1; US-Patent-5,810,556; US-Patent-Appl-SN-811378; US-Patent-Appl-SN-012940; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An improved, lightweight, turbine housing unit for an intermittent combustion reciprocating internal combustion engine turbocharger is prepared from a lay-up or molding of carbon-carbon composite materials in a single-piece or two-piece process. When compared to conventional steel or cast iron, the use of carbon-carbon composite materials in a turbine housing unit reduces the overall weight of the engine and reduces the heat energy loss used in the turbocharging process. This reduction in heat energy loss and weight reduction provides for more efficient engine operation.

Official Gazette of the U.S. Patent and Trademark Office

Carbon-Carbon Composites; Superchargers; Housings

19990089574 NASA Lewis Research Center, Cleveland, OH USA

Simulation of Crack Propagation in Engine Rotating Components under Variable Amplitude Loading

Bonacuse, P. J., Army Research Lab., USA; Ghosn, L. J., Case Western Reserve Univ., USA; Telesman, J., NASA Lewis Research Center, USA; Calomino, A. M., NASA Lewis Research Center, USA; Kantzos, P., Ohio Aerospace Inst., USA; Oct. 1998; 20p; In English; Applied Vehicle Technology, 11-15 May 1998, Toulouse, France; Sponsored by Advisory Group for Aerospace Research and Development, France

Contract(s)/Grant(s): RTOP 505-23-0M; DA Proj. 1L1-61102-AH-45

Report No.(s): NASA/TM-1998-208648; E-11366; NAS 1.15:208648; ARL-MR-418; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The crack propagation life of tested specimens has been repeatedly shown to strongly depend on the loading history. Overloads and extended stress holds at temperature can either retard or accelerate the crack growth rate. Therefore, to accurately predict the crack propagation life of an actual component, it is essential to approximate the true loading history. In military rotorcraft engine applications, the loading profile (stress amplitudes, temperature, and number of excursions) can vary significantly depending on the type of mission flown. To accurately assess the durability of a fleet of engines, the crack propagation life distribution of a specific component should account for the variability in the missions performed (proportion of missions flown and sequence). In this report, analytical and experimental studies are described that calibrate/validate the crack propagation prediction capability for a disk alloy under variable amplitude loading. A crack closure based model was adopted to analytically predict the load interaction effects. Furthermore, a methodology has been developed to realistically simulate the actual mission mix loading on a fleet of engines over their lifetime. A sequence of missions is randomly selected and the number of repeats of each mission in the sequence is determined assuming a Poisson distributed random variable with a given mean occurrence rate. Multiple realizations of random mission histories are generated in this manner and are used to produce stress, temperature, and time points for fracture mechanics calculations. The result is a cumulative distribution of crack propagation lives for a given, life limiting, component location. This information can be used to determine a safe retirement life or inspection interval for the given location.

Author

Crack Propagation; Simulation; Rotary Wing Aircraft; Variable Amplitude Loading

19990080645 Electro-Radiation, Inc., Totowa, NJ USA

EW Testing Lessons Learned

Berkowitz, Paul H., Electro-Radiation, Inc., USA; Jun. 16, 1998; 14p; In English

Report No(s): AD-A355203; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Electronic Warfare (EW) testing is one of the more challenging undertakings in the Avionics community. EW tests are typically fraught with a myriad of problems due to the inherent complexity of tests involving multiple vehicles, radars, data collection, and data processing, as well as the complex nature of Electronic Warfare itself. Electro-Radiation Inc. (ERI) has been at the forefront of EW testing for many years, from B-52 to B-2 and from F-101 to F-22. While it is impossible to prevent all problems, it is possible to prevent the same problems from repeating. This paper applies many of the lessons ERI learned from its extensive EW testing experience, and offers recommendations of how to avoid repeating them. Electro-Radiation Inc. (ERI) has been a leader in the field of Electronic Warfare (EW) testing for many years. During this time, it has been seen that the complexities of EW testing create an enormously challenging environment. A typical EW flight test involves multiple aircraft, both jammers and victims; ground test radars; ground reference radars; airborne reference radars; a central facility for real time flight and test control; telemetry and displays for real time observation; data collection; post data processing to generate error information; a laboratory to test and program the EW system, with associated signal sources, meters, scopes, monitors, test boxes, reprogramming tools, and spares for emergency repair/rework; and a classified work area with data storage for manuals and test data. For any single day's test, as many as 50 people from several Government agencies and contractors can be involved. In the center of this is the EW tester, who has responsibility for about 100 variables and control of perhaps 3. Given this complex scenario, it is not surprising that many problems arise. It is virtually impossible to run such an enterprise without problems.

DTIC

Avionics; Electronic Warfare; Aircraft Equipment; Flight Tests

19990080741 Kagoshima Univ., Faculty of Engineering, Japan

Heat Transfer and Flow Characteristics Behind Cylinders (Effects of Scale of Free-Stream Turbulence and Cylinder Size)

Torii, Shuichi, Kagoshima Univ., Japan; Fuse, Hajime, Kagoshima Univ., Japan; The Research Reports of The Faculty of Engineering, Kagoshima University; Sep. 1993; ISSN 0451-212X, No. 35, pp. 13-19; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experimental study was conducted on heat transfer from slightly heated circular cylinders in cross flow. Emphasis was placed on the combined influence of the scale of free-stream turbulence and the diameter of the cylinder on the rate of heat transfer at the rear stagnation point. by using a hot-wire anemometer, spectrum analysis of the anemometer signal with a Fourier analyzer is employed to investigate the separated shear layer formed behind the circular cylinder. The Nusselt number at the rear stagnation point varies with the scale ratio of turbulence and cylinder diameter, although the Reynolds number is the same. Corresponding streamwise profile of the separated shear layer is also influenced. The laminar-to-turbulent transition region moves in the streamwise direction because of a variation of the scale ratio. It was discovered that the heat transfer characteristics behind cylinders are affected by the scale ratio, and are closely related to the streamwise movement of the region of transition to turbulence in the separated shear layer.

Author

Flow Characteristics; Circular Cylinders; Free Flow; Turbulence; Scale (Ratio); Cross Flow; Aerodynamic Heat Transfer; Aerodynamic Characteristics

19990080839 National Aerospace Lab., Tokyo, Japan

Navier-Stokes Simulation and Linear Stability Analysis for a Boundary Layer on the Swept Cylinder

Nomura, T., National Aerospace Lab., Japan; Feb. 1997; 22p; In Japanese; Portions of this document are not fully legible

Report No(s): PB99-108912; NAL-TR-1321; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Techniques to delay laminar turbulent transition on the wing, called laminar flow control, are important for drag reduction of high speed civil transports cruising at supersonic speeds. The onset of transition is numerically predicted by computation of a boundary layer flow, linear stability analysis for the flow and integration of the spatial growth rates obtained by the analysis. Boundary layer flows used to predict the transition have been generally computed with boundary layer codes. In this paper, a Navier Stokes code is constructed for the computation. The supersonic flow around an infinite swept cylinder is computed with three types of grids which have different resolutions. The accuracy of the Navier Stokes code is tested by comparing velocity and tem-

perature profiles in the boundary layer obtained with these three grids. Furthermore, linear stability analysis for the attac' ment line boundary layer is performed.
NTIS
Navier-Stokes Equation; Stability Tests; Cylindrical Bodies; Boundary Layer Transition; Laminar Flow; Turbulent Flow; Swept Wings; Laminar Boundary Layer; Flow Stability

19990005959 Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan
Condensation and Evaporation of Refrigerants in a Plate Fin Heat Exchanger
Yara, Tomoyasu, Kyushu Univ., Japan; Koyama, Shigeru, Kyushu Univ., Japan; Fujii, Tetsu, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 61-69; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experimental study of condensation and evaporation of pure and mixed refrigerants in a plate fin heat exchanger was carried out. Pure refrigerants of HCFC22 and HFC134a and binary refrigerant mixtures of HCFC22/CFC114 were tested in the ranges of heat flux from 10 to 65 [kW/m2] and of mass velocity from 50 to 100 [kg/(sq m s)]. It is clarified that the heat transfer characteristics of condensation and evaporation in the experimental range are not affected by shear stress, but controlled by gravity force. The experimental values of local Nusselt number of both condensation and evaporation of pure refrigerants are ten times higher than the values predicted from a semi empirical equation for free convection condensation heat transfer of pure refrigerant inside a vertical tube, while the experimental values of refrigerant mixtures are lower than the predicted values and the difference depends on molar fraction.
Author
Evaporation; Refrigerants; Fins; Heat Exchangers; Condensation

15
MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19990008060 NASA Lewis Research Center, Cleveland, OH USA
Neural Network-Based Sensor Validation for Turboshaft Engines
Moller, James C., Miami Univ., USA; Litt, Jonathan S., NASA Lewis Research Center, USA; Guo, Ten-Huei, NASA Lewis Research Center, USA; Nov. 1998; 12p; In English; 34th; Propulsion, 13-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 519-30-53; DA Proj. 1L1-61102-AH-45
Report No.(s): NASA/TM-1998-208824; NAS 1.15:208824; E-11432; ARL-TR-1817; AIAA Paper 98-3605; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Sensor failure detection, isolation, and accommodation using a neural network approach is described. An auto-associative neural network is configured to perform dimensionality reduction on the sensor measurement vector and provide estimated sensor values. The sensor validation scheme is applied in a simulation of the T700 turboshaft engine in closed loop operation. Performance is evaluated based on the ability to detect faults correctly and maintain stable and responsive engine operation. The set of sensor outputs used for engine control forms the network input vector. Analytical redundancy is verified by training networks of successively smaller bottleneck layer sizes. Training data generation and strategy are discussed. The engine maintained stable behavior in the presence of sensor hard failures. With proper selection of fault determination thresholds, stability was maintained in the presence of sensor soft failures.
Author
Turboshafts; Turbine Engines; Neural Nets; Feedback Control; Engine Control

19990007055 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
A Rigorous Framework for Optimization of Expensive Functions by Surrogates *Final Report*
Booker, Andrew J., Boeing Aerospace Co., USA; Dennis, J. E., Jr., Rice Univ., USA; Frank, Paul D., Boeing Aerospace Co., USA; Serafini, David B., California Univ., Lawrence Berkeley Lab., USA; Torczon, Virginia, Institute for Computer Applications in Science and Engineering, USA; Trosset, Michael W., Institute for Computer Applications in Science and Engineering, USA; Nov. 1998; 22p; In English; Sponsored in part by the REDI Foundation

Contract(s)/Grant(s): NAS1-19480; NAS1-97046; DE-FG03-93ER-25178; F49620-95-1-0210; NSF CCR-91-20008; NSF CCR-97-31044; RTOP 505-90-52-01

Report No.(s): NASA/CR-1998-208735; NAS 1.26:208735; ICASE-98-47; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The goal of the research reported here is to develop rigorous optimization algorithms to apply to some engineering design problems for which design application of traditional optimization approaches is not practical. This paper presents and analyzes a framework for generating a sequence of approximations to the objective function and managing the use of these approximations as surrogates for optimization. The result is to obtain convergence to a minimizer of an expensive objective function subject to simple constraints. The approach is widely applicable because it does not require, or even explicitly approximate, derivatives of the objective. Numerical results are presented for a 31-variable helicopter rotor blade design example and for a standard optimization test example.

Author

Design Analysis; Rotary Wings; Optimization; Computer Design

19990089056 Old Dominion Univ., Dept. of Computer Science, Norfolk, VA USA

Sensitivity Analysis of Data Link Alternatives for LVLASO *Final Report, 6 Jan. - 30 Sep. 1998*

Mukkamala, Ravi, Old Dominion Univ., USA; Dec. 1998; 36p; In English

Contract(s)/Grant(s): NAG1-1853

Report No.(s): ODURF-163641; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As part of this research, we have modeled the Mode-S system when used to enhance communications among several ground vehicles to facilitate low-visibility landing and surface operations. The model has then been simulated using Bones Designer software. The effectiveness of the model has been evaluated under several conditions: (i) different number of vehicles (100, 200, and 300), (ii) different distributions of interarrival times for squitters: uniform, exponential, and constrained exponential, and (iii) Different safe distances (for collision purpose): squitter length, 1.5*squitter length, and 2* squitter length. The model has been developed in a modular fashion to facilitate any future modifications. The results from the simulations suggest that the Mode S system is indeed capable of functioning satisfactorily even when covering up to 300 vehicles. Certainly, about 10 percent of the squitters undergo collisions and hence the interarrival times for these is much larger than the expected time of 500 msec. In fact, the delay could be as much as 2 seconds. The model could be further enhanced to incorporate more realistic scenarios.

Author

Aircraft Landing; Landing Aids; Instrument Landing Systems; Enhanced Vision; Runway Alignment; Visibility

16
PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy; optics; plasma physics; solid state physics; and thermodynamics and statistical physics.

19990086649 NASA Lewis Research Center, Cleveland OH USA

A Fan Concept to Meet the 2017 Noise Goals

Dittmar, James H., NASA Lewis Research Center, USA; Nov. 1998; 16p; In English

Contract(s)/Grant(s): RTOP 538-03-11

Report No.(s): NASA /TM-1998-208663; E-11384; NAS 1.15:208663; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Aeronautics and Space Administration has established a goal of a 20 EPNdB reduction of aircraft noise by the year 2017. This paper proposes a fan concept for an engine that may meet this noise goal. The concept builds upon technology established during the Advanced Subsonic Technology Program which should show a 10 dB reduction potential. The new concept uses a two stage fan which allows low tip speed while still maintaining a reasonable total pressure rise across the two stages. The concept also incorporates many other noise reduction techniques in addition to low tip speed including a low number of exit guide vanes, swept and leaned guide vanes, a high subsonic Mach number inlet and syncrophased rotors to obtain active noise cancellation. The fan proposed in this paper is calculated to be able to achieve the 2017 noise goal.

Author

Noise Reduction; Aircraft Noise; Compressors; Engine Noise; Design Analysis

19990008660 NASA Lewis Research Center, Cleveland, OH USA

High-Accuracy Compact MacCormack-Type Schemes for Computational Aeroacoustics

Hixon, R., NASA Lewis Research Center, USA; Turkel, E., NASA Lewis Research Center, USA; Oct. 1998; 36p; In English

Contract(s)/Grant(s): NCC3-531; RTOP 523-36-13

Report No.(s): NASA/CR-1998-208672; NAS 1.26:208672; ICOMP-98-07; E-11396; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using MacCormack-type methods, a new class of highly accurate compact MacCormack-type schemes is derived which does not require a tridiagonal matrix inversion to obtain the spatial derivatives. Two examples are shown, and results of these schemes for three linear and nonlinear CAA Benchmark Problems are presented.

Author

Aeroacoustics; Matrices (Mathematics); Aircraft Noise; Screech Tones

19990008958 NASA Lewis Research Center, Cleveland, OH USA

A Fan Concept to Meet the 2017 Noise Goals

Dittmar, James H., NASA Lewis Research Center, USA; Nov. 1998; 16p; In English

Contract(s)/Grant(s): RTOP 538-03-11

Report No.(s): NASA/TM-1998-208663; NAS 1.15:208663; E-11384; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Aeronautics and Space Administration has established a goal of a 20 EPNdB reduction of aircraft noise by the year 2017. This paper proposes a fan concept for an engine that may meet this noise goal. The concept builds upon technology established during the Advanced Subsonic Technology Program which should show a 10 dB reduction potential. The new concept uses a two stage fan which allows low tip speed while still maintaining a reasonable total pressure rise across the two stages. The concept also incorporates many other noise reduction techniques in addition to low tip speed including a low number of exit guide vanes, swept and leaned guide vanes, a high subsonic Mach number inlet and syncrophased rotors to obtain active noise cancellation. The fan proposed in this paper is calculated to be able to achieve the 2017 noise goal.

Author

Noise Reduction; Aircraft Noise; Guide Vanes; Mach Number; Rotors; Tip Speed

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